CLAIMS

We Claim:

24. A hybrid reactor for anaerobic waste water treatment, combining the UASB (Upflow Anearobic Sludge Blanket) Process, making use of microorganism pellets, and the fixed-bed immobilization of microorganisms and comprising the following features:

(a) carrier elements for part of the height of the hybrid reactor for immobilizing microorganisms;

(b) a lower portion of the hybrid reactor between the lower confines thereof and the carrier elements, in the form of a space for degradation of waste water contamination by microorganism pellets;

(c) an upper portion of the hybrid reactor between the upper confines thereof and the carrier elements;

(d) a supply line for waste water to be treated and to be introduced into the hybrid reactor for the first time;

(e) a discharge system for finally discharging treated waste water from the hybrid reactor,

and further comprising the following features:

(f) a central flow channel extending from the top in downward direction and terminating at the top with a first distance from the upper reactor confines and terminating at the bottom with a second distance from the lower reactor confines;

(g) the carrier elements positioned in the annular space between the central flow channel and the reactor wall for the entire height of the flow channel or for part of the height of the flow channel for immobilizing microorganisms in the form of a structured, ordered fixed bed, are in the form of carrier elements that are porous to permit flow therethrough, and are arranged with flow passages of a width within a predetermined width range between adjacent carrier elements;

(h) a separator system serving to retain the microorganisms floating in the waste water in the hybrid reactor is provided in said upper portion of the hybrid reactor below said discharge system;

(i) the hybrid reactor, with respect to the internal flow thereof, is in the form of a loop-type column reactor such that waste water contained therein, inclusive of microorganism pellets, can be circulated through the central flow channel in downward direction, then through said space in said lower portion, then along the carrier elements in upward direction and finally again into the central flow channel.

25. The hybrid reactor of claim 24,
wherein plate-shaped carrier elements are provided.

26. The hybrid reactor of claim 25,
wherein a plurality of packages of carrier elements are distributed across the circumference of the hybrid reactor, with the plate-shaped carrier elements within each package being arranged parallel to each other and in tangential direction of the hybrid reactor.

27. The hybrid reactor of claim 24,
wherein the flow passages between adjacent carrier elements have a width of 3 to 6 cm, preferably 3.5 to. 5.5 cm, each.

28. The hybrid reactor of claim 24,
wherein carrier elements are provided that consist substantially of plastics particles and expanded clay particles that are unified with each other.

29. The hybrid reactor of claim 24,
wherein a recirculation system comprising a withdrawal system for waste water and a supply line for waste water for flow delivery into the central flow channel are provided.

30. The hybrid reactor of claim 29,
wherein the withdrawal system comprises an intermediate space between two plate-like elements as well as a conduit starting in said intermediate space.

31. The hybrid reactor of claim 29,
wherein the discharge system is positioned a distance above the withdrawal system of the recirculation system.

32. The hybrid reactor of claim 24,
wherein the separator system comprises a partition provided in spaced apart manner above the upper end of the central flow channel and covering a large part of the reactor cross-sectional area while leaving free an outer annular area.

33. The hybrid reactor of claim 32,
wherein the partition has portions in which it does not extend horizontally and forms a gas collection space in a highest portion.

34. The hybrid reactor of claim 33,
wherein, from the highest portion, the partition extends - roughly speaking - outwardly in downwardly inclined manner and inwardly in downwardly inclined manner.

35. The hybrid reactor of claim 32,
wherein a withdrawal system of the recirculation system is positioned at the upper side of the partition.

36. The hybrid reactor of claim 24,
wherein a first discharge line for gas formed in the hybrid reactor starts in the upper portion of the hybrid reactor.

37. The hybrid reactor of claim 32,
wherein a second discharge line for gas formed in the hybrid reactor starts in the region of the partition.

38. The hybrid reactor of claim 24,
wherein carrier plates are positioned in 15 to 40 %, preferably 20 to 30 %, of the reactor volume.

39. The hybrid reactor of claim 24,
wherein said lower portion of the hybrid reactor has a flow hindrance positioned on the wall thereof.

40. The hybrid reactor of claim 24,
wherein at least one driving jet outlet terminating below the lower end of the central flow channel is provided.

41. The hybrid reactor of claim 24,
wherein it is designed such that different kinds of microorganisms are provided as immobilized microorganisms on the one hand and as microorganisms of the microorganism pellets on the other hand.

42. A process for anaerobic waste water treatment in a hybrid reactor combining the UASB (Upflow Anearobic Sludge Blanket) Process, making use of microorganism pellets, and the fixed-bed immobilization of microorganisms, in which the waste water to be treated circulates in the hybrid reactor, such that waste water inclusive of microorganism pellets
(a) flows through a space in the lower portion of the hybrid reactor;
(b) then, in a space of the hybrid reactor located thereabove, flows along microorganisms that are immobilized in the form of a structured, ordered fixed bed on carrier elements that are porous to permit flow therethrough and form flow passages between each other;

(c) then flows to a separator system serving to retain microorganisms floating in the waste water in the hybrid reactor and separating the waste water into a first partial flow poorer in microorganisms floating in the waste water, and a second partial flow richer in microorganisms floating in the waste water;

(d) and finally, in the second partial flow, flows centrally in the hybrid reactor from the top in downward direction back into the space in the lower portion of the hybrid reactor.

43. The process of claim 42,
wherein part of the waste water of the first partial flow is branched off and pumped into a portion of the central flow as recirculation flow.

44. The process of claim 42,
wherein different kinds of microorganisms are provided as immobilized microorganisms on the one hand and as microorganisms of the microorganism pellets on the other hand.

45. The process of claim 42,
wherein waste water of a plant of the beverage industry, the feeding stuff industry, or the food processing industry is treated.

46. The process of claim 42,
wherein waste water of a plant of the paper industry or the textile industry is treated.

47. A use of the hybrid reactor of claim 24 for anaerobic waste water treatment of a plant of the beverage industry, the feeding stuff industry, or the food processing industry.

48. A use of the hybrid reactor of claim 24, for anaerobic waste water treatment of a plant of the paper industry or the textile industry.